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रेडियो बारम्बारता और समाक्ष केबल समुच्चय

भाग 2 नम्य समाक्ष केबल समुदायों के लिये अनुभागीय विशिष्टि

अनुभाग 1 सामान्य

Indian Standard

RADIO FREQUENCY AND COAXIAL CABLE ASSEMBLIES

PART 2 SECTIONAL SPECIFICATION FOR FLEXIBLE COAXIAL CABLE ASSEMBLIES

Section 1 General

ICS 35.120.10

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

May 1999 **Price Group 6**

Wires, Cables, Waveguides and Accessories Sectional Committee, LTD 18

NATIONAL FOREWORD

This Indian Standard (Part 2/Sec 1) which is identical with IEC 966-2-1 (1991) 'Radio frequency and coaxial cable assemblies — Part 2-1 : Sectional specification for flexible coaxial cable assemblies', issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Wires, Cables, Waveguides and Accessories Sectional Committee and approval of the Electronics and Telecommunication Division Council.

In the adopted standard, certain conventions are not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current pratice is to use a point (.) as the decimal marker.

CROSS REFERENCES

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 68-2-6 : 1970 (Fourth Edition), Environmental Testing — Part 2 : Tests, Test Fc and guidance : Vibration (sinusoidal)	IS 9000 (Part 8) : 1981 Basic environmental testing procedures for electronic and electrical items : Part 8 Vibration (sinusoidal) test	Technically Equivalent
IEC 96-2 : 1988 Radio frequency cables — Part 2 : Relevant cable specifications	IS 5801 (Part 1- Part 3) : 1970 Flexible coaxial radio frequency cables with characteristic impedance 50 Ω	do
IEC 410 : 1973 Sampling plans and procedures for inspection by attributes	IS 10673 : 1983 Sampling plans and procedures for inspection by attributes for electronic items	do
IEC QC 001002 : 1986 Rules of procedure of the IEC quality assessment system for electronic components (IECQ)	IS QC 001002 : 1988 Rules of procedure of the IEC quality assessment system for electronic components (IECQ)	Identical
IEC 966-1 : 1988 Generic specification for radio frequency and coaxial cable assemblies — Part 1 : General requirements and test methods	IS 14686 (Part 1) : 1999 Radio frequency and coaxial cable assemblies : Part 1 Generic specification — General requirements and test methods	do

The concerned Technical Committee responsible for the preparation of this standard has reviewed the provisions of the following International Publication and has decided that it is acceptable for use in conjunction with this standard:

IEC 332-1 : 1979 Tests on electric cables under fire conditions — Part 1 : Test on a single vertical insulated wire or cable

Only the English language text of the International Standard has been retained while adopting it in this Indian Standard.

IS 14686 (Part 2/Sec 1) : 1999
IEC 966-2-1 (1991)

Indian Standard

RADIO FREQUENCY AND COAXIAL CABLE ASSEMBLIES

PART 2 SECTIONAL SPECIFICATION FOR FLEXIBLE COAXIAL CABLE ASSEMBLIES

Section 1 General

1 Scope

This sectional specification relates to flexible coaxial cable assemblies operating in the transverse electromagnetic mode (TEM).

It shall be used together with IEC 966-1: Generic specification for radio frequency and coaxial cable assemblies. The numbering of the subclauses is the same as in the generic specification; for the missing subclauses, see the generic specification.

2 Object

This sectional specification establishes uniform requirements for testing the electrical, mechanical and climatic properties of flexible cable assemblies composed of flexible coaxial cables and coaxial connectors.

This sectional specification shall be supplemented with detail specifications giving additional details as required by the particular application.

3 Related documents

IEC 68-2-6: 1970 (fourth edition), *Environmental testing, Part 2: Tests, Test Fc and guidance: Vibration (sinusoidal).*

IEC 96, *Radio frequency cables.*

IEC 96-2: 1988, *Radio frequency cables, Part 2: Relevant cable specifications.*

IEC 332-1: 1979, *Tests on electric cables under fire conditions, Part 1: Test on a single vertical insulated wire or cable.*

IEC 410: 1973, *Sampling plans and procedures for inspection by attributes.*

IEC 966-1: 1988, *Generic specification for radio frequency and coaxial cable assemblies. Part 1: General requirements and test methods.*

IEC 966-1: 1990, Amendment No. 1.

IEC QC 001002: 1986, Rules of Procedure of the IEC quality assessment system for electronic components (IECQ).

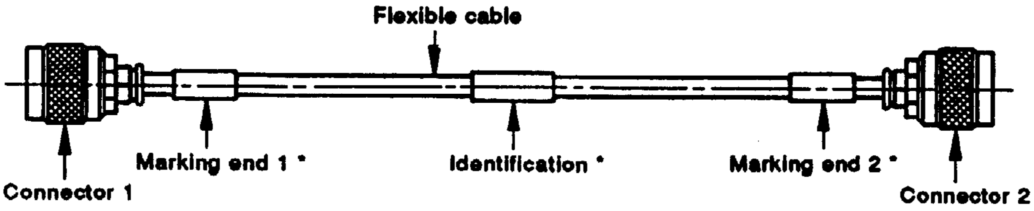
4 Definitions

4.1 *Flexible coaxial cable assembly*

A combination of a flexible cable and connectors used as a single unit with specified performance.

NOTE - Cable assemblies made in accordance with this sectional specification comprise a section of cable and two connectors. When specified in the detail specification, the assembly may additionally include markers for identification of the assembly and interconnecting ends. End caps and other accessories may also be specified.

For the purpose of this sectional specification, a cable assembly is always regarded as an integral unit. All specifications apply to the finished assembly and not to individual and non-assembled parts thereof.



* When specified

Figure 1 - Example of a cable assembly

5 Design and manufacturing requirements

5.1 *Cable design and construction*

Whenever possible, cables shall conform to IEC 96-2. If required, the manufacturer may use additional protective tubing or cable deviating from IEC 96, in order to comply with the requirements of the detail specification.

The materials used in the cable shall be given as engineering information in the detail specification.

5.2 *Connector design and construction*

The materials used in the connector shall be given as engineering information in the detail specification.

5.3 *Outline and interface dimensions*

The outine dimensions shall be in accordance with the detail specifications. If not further detailed, the specified length applies to the cable before stripping. The overall length of the assembly will be longer and depends on the connectors.

If not indicated in the detail specification, the length tolerance shall be ±1 % for cables equal or longer than 300 mm and ±3 mm for cables shorter than 300 mm.

SECTION 2: TEST METHODS

8 General

All test methods other than those indicated or described below are given in the generic or detail specification.

9 Electrical tests

9.1 *Reflection properties*

Whilst the parameter return loss (A_r) is preferred, the reflection factor (r) or the VSWR may be specified, where

$$A_r = -20 \log_{10} |r| \text{ and VSWR} = (1 + |r|) / (1 - |r|).$$

9.4 *Insertion loss stability*

The test frequencies or frequency range shall be chosen such that the measured insertion loss is at least ten times higher than the resolution of the test system.

In accordance with the flexibility characteristics of the cable assembly, one of the mechanical arrangements given in figure 2 shall be used. The test may not be appropriate for short cable assemblies.

Arrangements a) and b) provide for a transmission measurement by test methods 1 and 2. Arrangement c) provides for a reflection measurement by test method 3. Test methods 1, 2 and 3 are indicated in appendix B of IEC 966-1, Amendment No. 1. In addition to cable bending, arrangement a) implies torsional twisting around its longitudinal axis of 360° per turn.

During the measurement of insertion loss, the cable is first wound clockwise around the mandrel, released to the neutral position (starting position), wound counter-clockwise around the mandrel and again released to its starting position. The variation of insertion loss shall be recorded during these movements.

For long cable assemblies, the number of turns shall be chosen such that, after winding, 20 % or more of the length of cable is in contact with the mandrel.

The arrangement used shall be indicated in the detail specification. Arrangement a) of figure 2 is preferred.

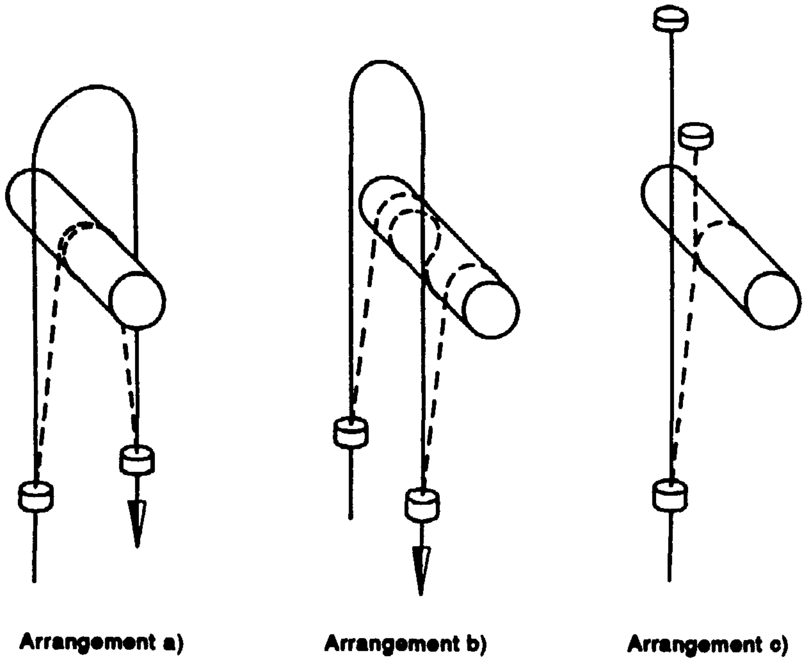


Figure 2 - Arrangements for testing insertion loss stability and stability of electrical length

9.6 *Stability of electrical length*

Depending on the flexibility, the torsional characteristics and the length of the cable assemblies, one of the following methods may be used to determine the stability of the electrical length as a function of the mechanical constraints.

Method I

The mechanical arrangement a) of figure 2 shall be used. During the measurement of the phase difference, the cable is first wound clockwise around a mandrel of diameter given in the detail specification. It is released to the neutral position (starting position), wound counter-clockwise around the mandrel and again released to its starting position. The variation of phase shall be recorded during these composite movements of twisting and bending.

Method II

For cable assemblies which are torsionally stiff, method I may not be appropriate. The stability of electrical length as a function of bending and twisting shall then be measured independently in two different arrangements.

Bending

The mechanical arrangement b) of figure 2 shall be used. During the measurement of the phase difference, the cable is first wound clockwise around the mandrel, then it is released to the neutral position (starting position), wound counter-clockwise around the mandrel and again released to its starting position. The variation of phase shall be recorded during these bending movements.

Twisting

The mechanical arrangement d) shown in figure 3 shall be used. During the measurement of the phase difference, the bow in the middle of the cable is first twisted in a clockwise direction then released to the neutral position (starting position), twisted counter-clockwise and again released to its starting position. The variation of phase shall be recorded during these twisting movements.

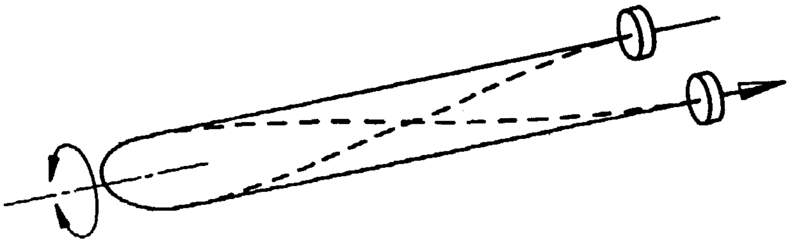


Figure 3 - Arrangement d) for testing stability of electrical length

9.7 *Phase difference*

If more than two cable assemblies belong to a matched set, the reference cable assembly shall be clearly marked.

9.8 *Phase variation with temperature*

Depending on the application of the cable assembly, one of two methods may be used to determine the variation of the phase as a function of temperature.

Method I: Phase change within a given temperature range

The frequency and temperature ranges shall be indicated in the detail specification. The result may be presented in degrees/GHz or degrees. The frequency normalised unit degrees/GHz is preferred.

Method II: Phase sensitivity as a function of temperature, i.e. the derivative of the phase change

The frequency and temperature ranges shall be indicated in the detail specification. The result may be expressed in degrees/GHz/K or degrees/K. The frequency normalised unit degrees/GHz/K is preferred.

10 Mechanical robustness tests

10.2 *Flexure*

If it is not defined in the detail specification, a force F shall be applied to the cable assembly such that the total load on the joint of the cable to the connector is equal to the weight of 10 m of the cable.

11 Environmental tests

11.1 *Recommended severities*

The severities for the environmental tests shall be chosen from appendix E of IEC 966-1, Amendment No. 1, unless otherwise indicated in the detail specification.

11.2 *Vibration, bumps and shock*

11.2.1 *Vibration*

11.2.1.1 *Procedure*

The tests shall be carried out in accordance with test Fc of IEC 68-2-6, Procedure B4.

The vibration severity shall be chosen from E.2.1 of IEC 966-1, Amendment No. 1, unless otherwise indicated in the detail specification.

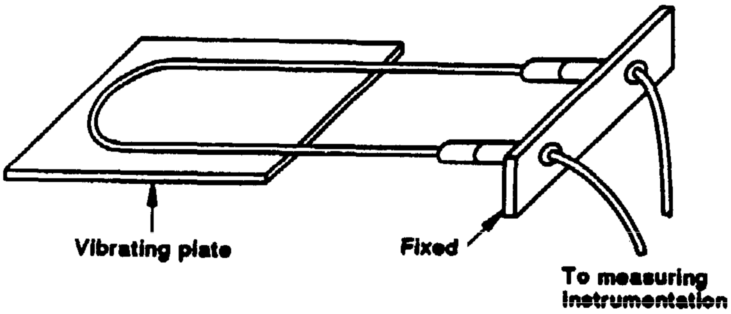


Figure 4 - Preferred arrangement for the vibration test

The preferred arrangement for the vibration test is described in figure 4. The cable portion of the cable assembly shall be vibrated in each of three perpendicular directions, one of which shall be parallel to the common axis of the connectors. The continuity of the inner and outer conductors shall be monitored during the test. The test equipment shall be able to reveal interruptions of 1 µs.

11.2.1.2 *Requirements*

There shall be no d.c. or low frequency discontinuity of the inner or outer conductor during the test.

After the test, the insertion loss and return loss shall not exceed the specified limits.

11.2.1.3 Information to be gven in the detail specification:

a) mounting details of the cable assembly;
b) severity parameters for vibration according to E.2.1 of IEC 966-1, Amendment No 1;
c) test parameters for continuity checking according to 9.12.4 of IEC 966-1;
d) requirement for insertion loss;
e) requirement for return loss.

11.2.2 *Bumps*

This test shall be specified, if necessary, in the detail specification.

For the recommended severities, see E.2.2 of IEC 966-1, Amendment No. 1.

11.2.3 *Shock*

This test shall be specified, if necessary, in the detail specification.

For the recommended severities, see E.2.3 of IEC 966-1, Amendment No. 1.

11.3 *Climatic sequence*

The test procedure indicated in E.2.4 of IEC 966-1, Amendment No. 1 is preferred.

11.4 *Damp heat, steady state*

See 11.4 of IEC 966-1 and E.2.5 of Amendment No. 1.

11.5 *Rapid change of temperature*

See 11.5 of IEC 966-1 and E.2.6 of Amendment No. 1.

11.6 *Solvents and contaminating fluids*

These tests are special tests for custom-built cable assemblies and, if required by 13.3, shall be indicated in the detail specification.

11.7 *Water immersion*

This test is a special test for custom-built cable assemblies and, if required by 13.3, shall be indicated in the detail specification.

11.8 *Salt mist and sulphur dioxide tests*

See E.2.7 and E.2.8 of IEC 966-1, Amendment No. 1.

12 Specialised test methods

12.1 *Flammability*

When required by the detail specification, the cable used in the cable assembly shall be tested in accordance with IEC 332-1.

SECTION 3: TEST SCHEDULES

13 Test schedules

13.1 *General*

In addition to the electrical, mechanical and environmental test requirements, the detail specification shall indicate the tests to be performed with the corresponding inspection levels, acceptance quality levels and periodicities. Whenever possible, in the place of individual tests, complete test groups from table 1 shall be specified, e.g. Eb, Ep, Vt.

With reference to table 1, notes apply as follows:

n = number of samples to be tested;

c = acceptance criterion;

IL = inspection level according to IEC 410;

AQL = acceptable quality level according to IEC 410.

NOTES

1 If the manufacturer wishes to replace these tests by analogous tests made on the connectors and the cable separately, he should demonstrate to the customer that the tests are such that the requirements of the detail specification will have been met at the final stage of inspection (modification of IEC QC 001002, subclause 12.3.4).

2 Only one of the tests 9.5 or 9.7 should be specified.

Table 1 - Grouping of tests for specification purposes

Recommended grouping of tests			Recommended severities					Notes
Group	Subclause	Tests	Periodicity	IL	AQL	n	c	
Ba	8.2	Visual inspection	Lot-by-lot	S3	4.0			
	8.3	Dimensional inspection	Lot-by-lot	S3	4.0			
Eh	9.1	Reflection properties	Lot-by-lot	II	1.0			
	9.3	Insertion loss	Lot-by-lot	II	1.0			
	9.4	Insertion loss stability	3 years	S3	4.0			
Eb	9.10	Voltage proof	Lot-by-lot	II	1.0			
	9.11	Insulation resistance	Lot-by-lot	II	1.0			
	9.12	Inner and outer conductor continuity	Lot-by-lot	II	1.0			
Ez	9.2	Uniformity of impedance	Lot-by-lot	II	1.0			
Ep	9.5	Propagation time	Lot-by-lot	100 %				2
	9.6	Electrical length stability	1 year	S3	4.0			
	9.7	Phase difference	Lot-by-lot	100 %				2
	9.8	Phase variation with temperature	3 years	*		3	0	1
Ee	9.9	Screening effectiveness	3 years	*	-	3	0	

Periodic tests noted with * shall be completed on a CQC (capability qualifying component) defined between the customer and his supplier.

Table 1 (concluded)

Recommended grouping of tests			Recommended severities					Notes
Group	Subclause	Tests	Periodicity	IL	AQL	n	c	
Mn	10.1	Tensile test	3 years	*	-	3	0	1
	10.2	Flexure	3 years	S3	4.0			
	10.3	Flexing endurance	3 years	S3	4.0			
	10.4	Cable crushing	3 years	S3				
Vv	11.2	Vibration, bumps and shock	3 years	*	-	3	0	
Vc	11.3	Climatic sequence	3 years	*	-	3	0	
Vt	11.4	Damp heat, steady state	3 years	*	-			
	11.5	Rapid change of temperature	3 years	*	-			
	11.6	Solvents and contaminating fluids	1 year	*	-			
	11.8	Salt mist and sulphur dioxide	1 year	*	-			
Vf	11.7	Water immersion	3 years	*	-			
	12.1	Flammability	3 years	*	-			

Periodic tests noted with * shall be completed on a CQC (capability qualifying component) defined between the customer and his supplier.

13.2 *Qualification approval procedure*

Under consideration as appendix G of IEC 966-1.

13.3 *Recommended qualification test schedule*

Table 2 - Test schedule

Group	Subclause	Tests	Specimens					
			1	2	3	4	5	6
Ba	8.2 8.3	Visual inspection Dimensional inspection	X	X	X	X	X	X
Eh	9.1 9.3 9.4	Reflection properties Insertion loss Insertion loss stability	X	X	X	X	X	X
Eb	9.10 9.11 9.12	Voltage proof Insulation resistance Inner and outer conductor continuity	X	X	X	X	X	X
Ez	9.2	Uniformity of impedance	X	X				
Ep	9.5 9.6 9.7 9.8	Propagation time Electrical length stability Phase difference Phase variation with temperature	X	X				
Ee	9.9	Screening effectiveness	X					

Table 2 (concluded)

Group	Subclause	Tests	Specimens					
			1	2	3	4	5	6
Mn	10.1	Tensile test	X					
	10.2	Flexure		X				
	10.3	Flexing endurance	X					
	10.4	Cable crushing		X				
Vv	11.2	Vibration, bumps and shock				X		
Vc	11.3	Climatic sequence	X	X				
Vt	11.4	Damp heat, steady state					X	X
	11.5	Rapid change of temperature						
	11.6	Solvents and contaminating fluids						
	11.8	Salt mist and sulphur dioxide						
Vf	11.7	Water immersion				X		
	12.1	Flammability						

13.4 *Capability approval procedures*

Under consideration as Appendix G to IEC 966-1.

The customer should preferably specify the tests in accordance with the appropriate groups defined in table 1.

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